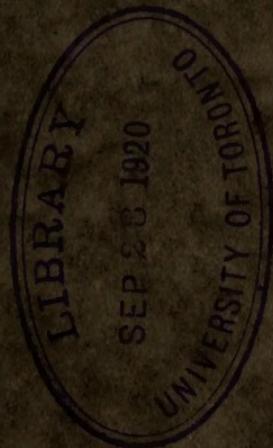


amph.
Econ.
Trade
B



THE OLIVE



THE OLIVE

BY

K. G. BITTING, M.S.,

BACTERIOLOGIST,

GLASS CONTAINER ASSOCIATION OF AMERICA

all yo
THE RESEARCH LABORATORY,
GLASS CONTAINER ASSOCIATION

OF AMERICA,

3344 S. MICHIGAN AVENUE,
CHICAGO, ILL.

COPYRIGHT, 1920

GLASS CONTAINER ASSOCIATION OF AMERICA

OLIVES

Olea europaea L.

There is no tree nor fruit which offers more in interest than the olive tree and its fruit. To obtain anything approaching an idea of its many-sidedness, it is necessary to become acquainted with the life and legends of ancient peoples, in which it entered as sustenance and as symbol; to know something of art, as the olive has furnished the motif for much decoration, both symbolic and purely esthetic; to know something of botany and horticulture, to appreciate its parts and to understand their structure and development; something of chemistry and physics, to understand its various constituents and their intelligent treatment; something of the culinary art, to understand its value and its varied uses as a food and condiment; of medicine, to appreciate the many virtues ascribed to it as a healing agent; and of cosmetics, to believe all that is claimed for it as a cleanser and beautifier. Each phase offers many fascinating possibilities, revealed through the most ancient as well as the most recent literature, for with time the olive has gained both in interest and value.

Origin

The olive according to De Candolle has been cultivated for more than 4,000 years, probably the longest period for any tree. Its early history is known only through ancient literature, and ancient remains

in which it served either as decoration or as a constituent. Through these its original home has been traced to Asia Minor, a region originally extending from Syria to Greece. That it grew on Mt. Ararat and was the harbinger to Noah of the recession of the flood is told in Genesis—"and the dove came in to him in the evening, and, lo, in her mouth was an olive leaf pluckt off."

The ancient Egyptians as a part of the fruit of their conquests obtained the olive during the 19th dynasty. Mummies, dating from the 20th to the 26th dynasty, have been found surrounded by garlands of olive leaves. From Egypt it spread into northern Africa. It is said to have been taken to Greece by Cecrops, the founder of Athens. The legend states that in the reign of Cecrops both Poseidon and Athena contended for the possession of Athens. The gods resolved that whichever of them produced a gift most useful to mortals should have possession. Poseidon struck the ground with his trident and straightway a horse appeared. Athena then planted the olive. The gods gave the city to the goddess from whom it was called Athenae.

Pindar says that all the slopes of Olympus were soon covered with it, and that the Athenians used to crown the victors in the Olympian games with its branches. Later it was used to crown their warriors and wise citizens. The method of oil extraction was also obtained from outside. The Greeks are supposed to have had the wild olive, Oleaster, previously, but the fruit of this is valueless. They are the

first European people to have cultivated the olive. Its cultivation spread to the surrounding countries, where the Greeks founded colonies, Sicily, the coast of Italy, and Gaul, these forming nuclei for its spread into the adjacent lands. Pliny states, however, that the olive was not introduced into Italy until 627 B.C., and that it reappeared in Gaul in 600 B.C., being carried to the latter country by the Phoenician colony that founded Marseilles.

The olive was carried later by the Romans into the countries in which they settled, Spain being the most notable, but it was also carried into the Iberian peninsula by the Arabs.

The Greeks and the Romans cultivated it on the northern side of the Mediterranean, the Tyrians on the southern side, the Arabs finding it there and carrying it with them into Spain when they settled in that country. The double origin of the olive, Greco-Roman and Semitic, in this latter country is borne out by the names bestowed on the olive. In southern Spain the tree is called *aceituno*, the olive fruit *aceituna*, and the oil *aceite*, the name evidently derived from the Arabic name *zeitoun*, this in turn being derived from the Hebrew *zeit*. In northern Spain both Arabic and Latin names are used, the tree is called *olivo* or *oliveira*, whereas the fruit and oil have the Arabic derivative names *aceituna* and *aceite* respectively, but the oil used in the church and in painting is called *oleo*. In Portugal similar conditions prevail, the cultivated olive is called by the Greco-Latin name *oliveira*, whereas the wild olive is

called by the Arabic name *sambugeiro*, the fruit *azeitona*, and the oil *azeite*.

Though some botanists claim that the olive is native to the Canary Islands, no word for it is found in the remains of the language of the Guanches, an ancient, but extinct, race of people who inhabited the islands. The available records show the tree to have been introduced there since 1403, and probably by the Phenicians.

The olive was introduced by the Spaniards into Chili, Peru, Mexico, and the United States. From Mexico it was brought by Jesuit missionaries into Lower California, the first settlement being at Loreto, in 1697. The Jesuits founded fifteen missions, but were superseded by Franciscans in 1768. These latter proceeded northward to extend their work, the first of their missions being founded in 1769, at San Diego. The secular head of the mission, representing the King of Spain, had the foresight to carry the seeds of flowers, fruits, grains, and vegetables, so that flourishing gardens were soon brought into existence. When the missions went into secular hands in 1843, the gardens in many cases were neglected and many of the fruit trees died. The olive was one of the trees that withstood the neglect and was afterwards used for cuttings by the emigrants from the eastern states who came in 1849. From this time on the olive has received considerable attention, many experiments being made in its culture, and in recent years the plantings have increased to an enormous extent, due to the favor accorded to

both the oil and the fruit. It has spread around San Diego and Los Angeles east into the San Joaquin Valley and north into the Sacramento Valley in California, and also into Arizona. In the latter state its cultivation is comparatively recent, so that only about 5 per cent of American olives are produced there.

At the present time the olive is cultivated more or less extensively in the countries surrounding the Mediterranean—Asia Minor, Turkey, Greece, Italy, Austria, France, Spain, Portugal, Tunis, and Algeria. In the Western Hemisphere the main source is California, though the olive is cultivated in some of the countries of S. America.

Duration

The olive tree is of slow growth, but if allowed to grow naturally, it persists for centuries and attains a great size. De Candolle describes one tree 23 feet in circumference, its age supposed to be over 700 years. Tournefort found fruitful old olive trees between Ephesus and Smyrna which must have been planted before the Mussulman invasion, as Turks had not planted olives, not esteeming them. The Mount of Olives on the east side of Jerusalem was among the places best cultivated. Near its foot was the grove called Gethsemane (Gath-Semen, oil press) because of the olives with which it was covered and those of the slopes above where an abundance of oil was pressed out. In the Garden of Gethsemane there remain only eight of these olive trees that are supposed to have existed at the beginning of the Chris-

tian era. Chateaubriand, writing in the early part of the nineteenth century of these olive trees, said, "one sees there eight olive trees in extreme decrepitude." An article written recently by J. D. Whiting, American Vice-Consul at Jerusalem, had an interesting statement relative to one of these trees. "El Butini, the most famous of the Garden of Gethsemane's eight olive trees, under which the Savior is supposed to have walked during the night of agony, has recently collapsed. The great tree was weakened by the locust plague during the spring and summer of 1915. When El Butini falls, then falls the Turk, runs the legend."

Throughout Europe and Asia are many old olive trees, some of them producing abundantly, their origin, however, lost in remote centuries. The olive is very tenacious of life, but the methods of cultivation, which tend to increase production, reduce resistance and diminish its duration of life.

Etymology

The generic name *Olea* is from the Greek *elaia*, derived from the Celtic or Gothic *olew*, oil, on account of the abundance of oil in the fruit. The specific name *europaea* is given to the species cultivated throughout Europe.

The olive has been given fanciful names by the early peoples. It was known as the "tree of wisdom," "Minerva's tree," the "Gift of Heaven," etc. The Greeks consecrated the tree to Minerva, and made it the symbol of wisdom, abundance, and peace.

Description

The olive is an evergreen tree about 20 to 30 feet high, much branched and spreading. It forms a symmetrical head, having angular branches and opposite leaves. The leaves are dry and leathery in texture, lanceolate, entire, deep green above, and light hoary beneath. The flowers are small, star-shaped, creamy white with yellow centers, have a faint pleasing odor, and are axillary in compact racemes. The fruit, a fleshy pendulous drupe, is very abundant. It is oval, obovate, or globular in shape, about the size of a pigeon's egg, dull greenish yellow even when full size but unripe, then gradually becomes yellow, red, and finally turns a glossy purplish black or black when ripe. In ripening, the side exposed to the sun reddens, then gradually the whole fruit changes from red to purple, then black. As fruit of all degrees of ripeness are developed at the same time, the tree furnishes an extremely beautiful combination of colors, the various greens of the leaf and fruits forming a background for the splotches of red, purple, and black formed by the ripening fruit. The fruit is peculiar in two respects, first, in that it contains in addition to the ordinary constituents of fruits an abundance of edible oil, consequently making it a valuable food; second in that it contains a bitter substance which does not disappear on maturity, so that the fruit cannot be eaten at any stage in its development without preliminary treatment for the elimination of this substance. The

stone is two-celled, many times only one seed developing.

Climatic Requirements

The olive requires rather warm temperature, light humidity, and absence of heavy frosts. It can withstand temperatures of -7 to -8 degrees C. or even lower if not too prolonged, and if the change to higher temperature be gradual. Moist cold is more unfavorable than dry. The altitude at which it will grow depends on the local climate. The climate of the countries bordering on the Mediterranean and that of California are particularly favorable.

Varieties

The wild olive Oleaster is said to have been the original form, called by Linnaeus *Olea europaea sylvestris*, later by De Candolle *Olea europaea oleaster* and the cultivated form *Olea europaea sativa*. The reason for this belief is said to be the *oleaster* seeds reproduce trees true to type, whereas the seeds of *sativa* produce trees having the characteristics of *oleaster* but, though *oleaster* under cultivation becomes modified in various ways, it does not produce fruit like *sativa*. Whichever form was the original, the subjection to cultivation for over 4,000 years, under the varying conditions of soil, climate, and methods of cultivation, has produced many varieties. Many of these doubtless are the result of accidental modifications, more or less fixed by successive cultivations. At the present time there are certain well-defined varieties which are cultivated,

and of which the characteristics are well known, so that varieties may be selected according to the purpose desired, whether for the preservation of the fruit green, half ripe, or ripe, or for extraction of oil.

Of the large number of varieties introduced into California, Wickson reports analyses made by the State university on 57 varieties. Of these only a comparatively few were retained as worthy of cultivation, chief among these being the Mission olive, the one planted originally in California in the old mission gardens. Wickson states there are several sub-varieties of this form.

Propagation

The olive is propagated by means of seeds, cuttings, grafting, and budding. Propagation by seeds is seldom done in this country, as it is so much slower and more troublesome than by cuttings, aside from the fact that the desired variety may not result. The pulp has to be removed, which is done usually by allowing the fruit to rot or by softening with an alkali. Unless removed from the stone, the seed may not develop for two years, otherwise the seed usually sprouts the first year.

Propagation by cuttings is the commonest and easiest method, as the cuttings root readily, and either old or new wood may be used so that the cuttings may be large or small. Cuttings sent from Europe are usually in the form of truncheons, and these may be cut into pieces like firewood and will root.

The story is told of a grove in Morocco in which the trees exhibited a peculiar arrangement. The reason given for this was that a king and his army on the way to the Sudan had encamped for the night, and stakes or pickets to tie the horses had been cut from a grove near by. The pickets were left and had developed into trees. This seems probable enough when it is considered that pieces of branches are taken, one end whittled to a sharp point and driven into the ground, and that these pieces will take root and develop. An olive company in California has recently transferred 3000 trees, 26 years old, from San Joaquin County to Oroville and Marysville. The trunks were sawed off about 18 inches above the ground, and the roots 12 inches from the stump. In a planting made 6 years previously the same method was used and resulted successfully.

Where trees are found undesirable for some reason, resort is had to budding or grafting. By these means the undesirable trees are not a complete loss, and results are obtained sooner. Many times varieties are obtained from Europe which on developing are not found suited to the conditions in this country; these plants may be used as stock for desirable varieties or some desirable variety is obtained which may be propagated rapidly by these means.

The pruning must be done by persons of understanding, as the fruit is borne only on the two-year portion of the branches, and provision must be made



Gathering Olives

to cut excessive growth in the season of too heavy development and stimulate in the season of poor development. The pruning thus regulates the growth of the branches which two years later will control the production of the fruit.

Pruning of very large branches is sometimes done to admit more light and heat to the darker, cooler parts of the tree. The small branches thus provided in turn furnish nursery stock. Pruning is done in late winter and early spring. From March to October no pruning is done, but the trees are carefully tended through cultivation, irrigation, and fertilization.

In California the young stock is set out in the groves in April, and about 35 feet apart. During the non-bearing period, the land between, which like all California groves, is kept in good cultivation and free from weeds, is utilized frequently for other crops.

Though numerous stories are written of the remarkable ability of the olive tree to grow and bear in exposed situations, and with only small amounts of soil and water, the olive, like all other fruit trees, requires both cultivation and an adequate amount of water if a constant and abundant harvest be desired. As the groves are irrigated, the proper amount of water may be supplied at all times. The water is conducted through a system of underground pipes, which are provided with outlets at the end of each row of trees. From these outlets the water is directed into furrows to water the trees.

As the irrigation is conducted by underground pipes, the groves are easily cultivated.

Products

It would seem that the olive is rightly and appropriately called the "Tree of Abundance," for all parts of it have been used, and to the ancients, even with their limited cuisine as compared with that of today, it was a symbol of plenty, witness the apostrophe of King Sennacherib, made centuries before the Christian era, who called Assyria "A land of corn and wine; a land of bread and vineyards; a land of oil, olives, and honey."

FLOWERS

In ancient medicine the blossoms of the olive were highly esteemed, but are not mentioned in the medicine of today. They were used as poultices to alleviate pain, sometimes alone, sometimes mixed with other substances.

LEAVES

The leaves were also used in medicine, a decoction made from them being said to stop bleeding, and on account of their astringency to reduce inflammation. The leaves and bark have an acrid and bitter taste, and have been prescribed as substitutes for cinchona. In France an extract of the leaves is used as a febrifuge, and has also been found valuable in preventing hectic paroxysms.

From time immemorial the leaf and branch have been employed as a symbol of peace, and have appeared in sculpture and painting. No more beauti-

ful emblem than the olive branch can be selected or devised to symbolize both peace and victory, and as such has been known through all the ages. Egyptian mummies, dating from the 20th to the 26th dynasty, have been found surrounded by garlands of olive leaves, and the tomb of the hero of today will oftentimes have its sculptured olive branch, telling its story and making its appeal stronger than could be made by words.

Besides serving for esthetic purposes, the leaves, in spite of their astringency, are eaten by animals as forage, so that the trees have to be protected from them. It is curious that with all the ravages made by animals on the olive trees in the neglected mission gardens in California, after the missionaries had gone, some of these same trees furnished scions for many of the olive groves of today.

WOOD

The wood of the olive tree is much prized for certain purposes. It is very close, fine-grained, yellow to yellowish brown with irregular wavy brown to black lines and mottlings, especially near the root. It has no distinguishable annual rings or pith rays, and has evenly distributed vessels. It takes a beautiful polish. At present it is employed chiefly in lathe-work and carving for small fancy articles, and for cabinet work.

In ancient times it seems to have had a much wider application, due no doubt to the size of the trees, which were larger as a result of not being

subjected to the rigorous cultivation and pruning which they receive today. The Bible states that olive wood was used in the Temple. In the time of Pliny it furnished material for construction of ships, for wagon spokes, wedges, columns, pedestals, statues, and furniture. The Romans used both the wild and cultivated trees. The wood industry was developed in the vicinity of Nice in both France and Italy, and still flourishes. A considerable amount has been exported to England in recent years for the manufacture of walking sticks. The poorer quality is used for firewood, is inflammable, and produces great heat.

BARK

The bark contains a large amount of tannin. For medicinal purposes it is reduced to powder and acts as an astringent, a tonic, and a febrifuge. In warm climates a resin is exuded from it which solidifies in the air. It is called Lecca gum, as it was first found near Lecca. It contains some benzoic acid among other constituents and in ancient times was prescribed in medicine, but is not at present, and the gum is considered valueless.

FRUIT

The fruit has been considered a choice food at all times. It has appeared at the feasts of epicures, both ancient and modern, as a relish, and to be eaten at the end of the repast as part of the dessert, and at all times it has also furnished a staple food for the poor in the Orient and in Greek and Latin

countries. Those who were well provided were admonished to have care for those less fortunate: "When thou beatest thine olive tree, thou shalt not go over the boughs again; it shall be for the stranger, for the fatherless, and for the widow." (Deuteronomy XXIV., 20.) The people obliged to live frugally have found it a great resource, particularly in Lent and for those at a distance from the sea unable to obtain fresh fish. It is said that Plato preferred olives to all other foods, and often made a meal on them alone.

Though olives are known and consumed throughout the civilized world, comparatively few persons, aside from those living in the regions of their cultivation, know that olives have to undergo certain treatment before they can be eaten. It is a common practise in olive regions to encourage the visitor to taste the fruit directly from the tree. The fruit, both green and black, looks so fine and tempting, that the disgust on tasting is correspondingly great. It is claimed that some of the older varieties could be eaten without preparation, that they dried naturally, and were sweet like raisins.

The olive contains a bitter and acrid substance or substances which must be removed before the olives are edible. It is referred to in most of the literature as a "bitter principle", and has been called an acid, a tannin, and more recently a glucoside. Cruess has repeated the work of the various investigators, who claimed these different substances, and as a result has come to the conclusion that it is a

glucoside, that is, a combination of glucose with another compound.

In immature fleshy fruits there is usually an accumulation of acids, tannins, and sometimes starch. As ripening proceeds, carbohydrates and aromatic substances are formed, and the bitter, acrid, or astringent taste disappears. In the olive there is no starch found at any stage of maturity. Glucose has been found in all stages, and is supposed to be the substance from which the oil is formed. The oil is in very minute quantities in the fruit up to the time when the pit is formed, from then on it increases gradually up to its maximum when the fruit is not quite mature. In the plant economy the fat or oil is one of the most important food reserves of plants. All parts of the fruit—rind, flesh, stone, and seed—contain oil, the fleshy part, forming about 80% of the fruit, containing the largest amount.

Contrary to the condition existing in most fruits, the bitterness remains through all stages of development in the olive. A substance of glucosidic nature, given the name "oleuropeine", has been isolated, and found to be of extreme bitterness. This may be the substance or one of the substances which cause the inedibility of the untreated olive.

The oil is the most important constituent of the fruit on account of its high food value and its use in the industries. It is used to a large extent in cold countries and also in dry countries where there are few cattle, the oil taking in the various culinary operations, the place of butter and other fats.

Among the ancient Jews the oil was considered indispensable and as necessary as bread. An abundance of oil was looked upon as a blessing from God. Vast public storehouses were constructed to hold it for the scarce years. To the Greeks the three indispensable foods were oil, grains, and wine, the oil entering into most of their dishes. The Romans had a large trade in the oil, and it was also used, to a large extent, in their domestic cooking. In Italy and Spain street vendors fry fritters in the oil and sell them while hot. It has considerable use in conserving fish, particularly sardines. The higher grades of French, Spanish, Norwegian, and American sardines are packed in olive oil. This use has been extended in recent years to the packing of tuna fish.

Olive oil occupies a high position as a vegetable fat. Many others have been prepared and offered as substitutes, and if judged by chemical composition alone, give practically equal food value, but are lacking in the delicious flavor which makes olive oil distinctive and gives it a superiority over all other oils.

The oil is a large factor in the industries; it serves as an extractive of perfumes, as a constituent of fine, smooth soaps, and as a lubricant in watch factories. Formerly the lower grades were used commonly for lubricating purposes, but with improved methods of clarifying and the greater expense attendant on its use, it has been superseded by cheaper lubricants.

An enormous quantity has been and is still used in religious ceremonies, in the ordinations of the clergy and rulers, and anointing in the sacraments, besides by old world peoples generally in the lamps in the churches and temples, many of which are kept burning continually. An idea of the vast amount consumed for this purpose can be obtained from the fact that in one mosque alone there are 1,200 lamps burning constantly, and requiring about 25,000 kilos of oil annually.

In medicine it has been and is still used extensively. The ancients rubbed it on their bodies to make the muscles supple and to cleanse and protect the skin, particularly after bathing, and it still functions for these purposes. It was used to heal wounds, in liniments, and as a mild laxative. At present it is a constituent of liniments, ointments, cerates, and plasters. The people who are habitual patrons of the olive and its oil are noted for their smooth, beautiful complexions. It is said "the warm rosy complexion of the Italian and Sicilian women is due to the free use of olive oil as much as to the air and climate of their country."

The residue or marc which remains after the oil is extracted is used as a food for sheep and hogs, for fertilizer, and for fuel, and there is obtained from it a clear, illuminating gas.

PREPARATION OF FRUIT

Foreign

In the early preparation of olives in order to remove the bitterness, they were soaked in water, which was renewed from time to time, sometimes hot water being used. The olives, after draining, were then held in brine. The green olives as well as the mature and black were used.

The Romans exercised the greatest care in their preparation, and introduced refinements, by not only removing the bitterness, but by causing them to acquire various flavors through infusion in solutions containing aromatic substances.

One of their methods for the preparation of green olives consisted in adding roasted salt to the olives after a preliminary soaking in hot water, then covering them with grape must, boiled wine, or honey water, and to this solution were added fennel, mint, and lentiscus seed. Fennel was used as a tampon to keep the olives immersed. A simpler method was to use vinegar with the brine. Sometimes the olives were beaten to facilitate the action, but this caused discoloration, which was avoided by making cuts in them. The brine was replaced by oil as a preserving liquid. Another method was to put the olives with the aromatics in the brine at the start, then they were removed, crushed lightly, and put in a mixture of oil, vinegar, and honey, to which were added leek, celery, mint, and sometimes rue. The rue was supposed to be most efficacious in bringing out the natural flavor, and was

most prized. The mature olives were first put in brine for 30 to 40 days, then put in the preserving liquid with the aromatics. Olives prepared in the ways indicated were known as "Colymbades".

A form of conserve made by the ancients, and to which the name "Epityrum" was given, consisted in taking green, mature, or black fruit, though, as in the former, the green were preferred, and drying them in the shade, after which they were put in baskets, and crushed in a press. The crushed fruit was then put in vessels, sprinkled with salt, and had mixed with it lentiscus seed and minced leaves of fennel and rue, and was finally covered with oil.

Many recipes have been left by the ancients, the preparations varying as to time, strength of solutions, mixtures of spices, etc. To the recipes of Palladius (1518-1580) is owed the knowledge that the Romans were cognizant of and used lye solutions, though this is supposed to be a modern practise. In this particular recipe sifted ashes are indicated as one of the ingredients, and it is supposed that this recipe, changed in detail, furnished the basis for present day methods. The use of wood ashes was introduced into France by an Italian refugee named Picholini, who settled in Provence, devoting himself to the preparation and sale of preserved olives. The olives preserved according to his process are called "olives a la Picholine". Previous to his time the preparation in southern France consisted of crushing the olives lightly, immersing in clear water, which was renewed each

day for about nine days, then preserving in brine. This latter process is still employed for the olives in which appearance is not an asset. For the more carefully prepared ones, the method was to pick by hand when the olives had attained full development, then they were carefully sorted, and immersed in lye, the duration in the lye depending on the size of the fruit, and the concentration of the lye. They were removed from the lye when the flesh was penetrated to, and readily detached from, the stone.

There are many variations of the lye treatment. In the olive countries the preparation is done in the homes as well as in factories, and it is in the homes, naturally, that the greatest variations occur. Lime is often used with the ashes, one formula consisting of the olives mixed with a paste of wood ashes and freshly slaked lime. In the ordinary methods, however, a solution is made of the sifted ashes and lime, sometimes sodium carbonate taking the place of the ashes. In the ordinary factory preparations both ashes and lime are omitted, and either caustic soda or potash used. When removed from the lye, the olives are put in clear water, changed night and morning for three or four days, then put in brine.

The early accounts of olive preparation show quite conclusively that great variation in strength of the caustic solution was inevitable, but fortunately the tendency to err was on the weaker side. It was not until the modern introduction of caustic

preparations of soda and potash that standardization of the process was possible. Even with this possibility the practise remains largely empirical and is based upon the experience of the operator. Some still adhere to the use of weak solutions, taking considerable time to act upon the olive, whereas others use relatively strong solutions so as to hasten the process.

The brine used has been subject to quite as marked variation as the lye. A weak brine has been used in order to encourage the natural fermentation of the fruit, which corresponds to the fermentation in our cucumber pickles. The other extreme is represented by the use of a very strong brine which practically inhibited all fermentative change and this same brine was filtered and used a succeeding season. Every gradation between these extremes has been in common use. As might be expected, more or less of the fruit softened and underwent changes which at present would be regarded as decomposition or rotting rather than as clean, normal fermentation. The esthetic side of olive preparation has not always been of the highest order, though, as in the case of many other foods, very great improvement has been wrought in recent years.

Even with the later methods the use of aromatic substances has not been abandoned, and many of these are used, such as bay leaves, cloves, coriander, cumin, mint, orange skin, fennel, etc., the amounts and combinations varying greatly. Sometimes the

aromatics are first extracted, the solution concentrated, and a quantity of this solution added to the brine, or they are boiled in the brine at the start, then removed, and when the brine is cooled, it is ready for use.

In Spain the ripe olives are not treated ordinarily with lye, but by the slower process of soaking in water. The black olives, gathered late in the year, are cured in a salt brine to which black pepper is added. After the bitterness is removed, they are preserved in oil.

A process used at present for ripe olives which is very simple but effective, is to mix fine salt with them after they have been cleaned and sorted. They are stirred twice a day, and through the osmotic action of the salt, a dark-colored juice is exuded which contains, among other constituents, the substance causing the bitterness. To hasten the action the olives are pierced with a needle. The Spaniards vary this method by adding aromatics, as wild marjoram, thyme, fennel seed, anise seed, garlic, laurel leaves, etc., at the same time as the salt. The special spice mixtures are held as trade secrets by the manufacturers.

When the bitterness has been removed, the olives are washed, dried lightly, and placed in casks or jars until required. Before being served the olives are soaked in oil.

One style of Greek packing of ripe olives is of special excellence. Sour wine is added to the pickle to accentuate the flavor and the product is packed in

oil. The olives are plump, tender, and brilliant, and possess a very rich flavor.

In parts of Southern Europe certain kinds of olives are left on the trees to become very ripe, and are then dried in the sun without any preparation. These are only used locally as they are lacking in the fine flavor of the prepared olive.

In the preparation of the olive, both green and ripe, during all these centuries, there had been no attempt at sterilization. The olive was preserved by partial drying, by the action of salt, and by its spontaneous fermentation in pickle in which certain desirable forms of organisms had the ascendancy. With the good fruit thus prepared, there must have been considerable which was spoiled, and yet no illness is known to have resulted.

Though olives have figured so largely in the alimentation of southern Europe, the oil particularly being so important and general a food, the people of northern Europe have not esteemed either to an important extent. With the crude methods in vogue for transporting the oil, and the lack of understanding as to its nature, it is supposed that their apathetic attitude was due to its being received in poor condition.

In England also, though so close to the olive growing districts, the olive has not been used to any considerable extent, judging from its absence from menus and from their cookery. In examining old cookery books it was surprising to find no mention of olives. In Russel's "Boke of Nurture" and Mrs.

Napier's "Noble Boke off Cookry" the manuscripts dating from the 15th century, there is no mention of olives, though there are condiments and spices from foreign countries used in sauces and other preparations. Neither is there any mention of olives in "The Closet of Sir Kenelm Digby Opened" written in the 17th century, though Digby had traveled much and lived on the continent. The earliest mention in 17 cookery books, published in the 17th and 18th centuries is the following, published in 1745, and which is really a translation of a French work by L. Lemery, physician to the King, and member of the Royal Academy. It is interesting in showing the many virtues attributed to olives.

"OF OLIVES"

"You ought to chuse such as are large, pulpy, well preserv'd and tasted, and those that have been cultivated in hot Countries.

They create an Appetite, fortify the Stomach, dissolve and expell the viscous and gross Humours fix'd there, repress Reachings, and are a little nourishing.

They produce no ill Effects, unless they are us'd to excess.

They contain much Oil, Phlegm, and essential Salt.

They agree in cold Weather with any Sort of Age and Constitution, provided they are good, and well preserv'd."

Remarks

"*Olives* are oblong or oval and juicy Fruits, larger or smaller, according to the Country they grow in:

Care must be taken to gather them before they are ripe, and then they have a harsh bitter Taste not to be endured, because their salts are clogg'd and swallow'd up by the earthy and gross Parts.

Olives are preserv'd with Water and Salt, and then they become pleasing to the Taste; the Reason is, because the Liquor of Brine causes a little Fermentation in the *Olives*, by the Help thereof the Salts free themselves by degrees of the earthy Parts that do retain them; and afterwards with more Lightness and Delicacy prick the nervous Fibres of the Tongue.

"The Brine produces another good Effect in the *Olives*; for by its saline Parts it stops up the Pores of this Fruit, and prevents the Air from ent'ring too much into it, and thereby cause a considerable Fermentation therein, which destroys the Fruit, and soon rots them.

Olives well preserv'd create an Appetite, by gently pricking the Sides of the Stomach, not only by their acid Salts, but also by those communicated to them by the Pickle. They also bind up and fortify the Stomach by their earthy Parts, which swallow up the over-abounding Moistures that relax the Fibres of that Part.

The *Picholines* are *Olives* cut in several Places, and then steep'd in Pickle; they are sooner in a Condition to be eaten than others, because that by the Help of the Incision made in them, the Brine or Pickle is sooner and more effectually communicated to their whole Substance.

Oil of *Olives* is much us'd in Ailments; it's of a qualifying, mollifying, anodine, dissolving and detergent Nature, good for the Cholic and Bloody-flux, and is prepar'd in this Manner.

They get together in November or December, a

great Quantity of full ripe *Olives*, and lay them by for a Time in some Corner of the House, where they are heated, and thereby become purified of their watry Moisture; then they grind them in a Mill, and put them into Rush or Palm Frails, plac'd on the Top of one another Pressways, and the first Oil that comes from them, is called *Virgin's Oil*.

They sprinkle the *Olives* with warm water, and by pressing them a-new, and still the more, there comes a good Oil from them.

This done, they stir the *Olives* again, and sprinkle them with hot Water, from which, thus order'd, there proceeds another Oil full of Dregs, and not so good as the rest.

These Oils are easily separated from the Water, because they swim a top, but they find a Kind of Lees to the Bottom, which the Ancients called *Amurca*.

Those *Olives* of which you design to make Oil, must ripen 'till they are even rotten; and the Reason is, because the sulphurous Parts in them have had Time to disengage themselves from those gross Principles, which before fix'd them, which we know by the sweetish and oily Taste that then they had. They also let them ferment for some time before they press them, that so those sulphurous Parts may free themselves, and be more fully separated from the watry and saline Parts, with which they were united in the Fruits. Here it is to be observ'd that you cannot extract a Drop of Oil from green olives, but only a viscous Juice, because their oily Principles are very strictly united with their other Principles.

The Leaves of the *Olive-Tree* are astringent, and fit for to stop the Bleeding of the Nose, and Looseness.

There are certain wild *Olive-Trees* that grow near the Red-Sea, from which there sweets out a Gum that stops Blood, and cures Wounds.

The *Olive-Tree* in Latin called *Olea*, comes from the Greek Word *elaia* which also signifies the same Thing."

A later work, "The Lady's Assistant" published in 1778, gives a much better idea of how little they were used at that time in England.

OLIVES

"OLIVES are the fruits of trees, which grow wild in the warmer parts of Europe; we have them in some of our gardens; but with us they will not ripen to any perfection.

There are three kinds, the Italian, Spanish, and French; we have them therefore of various sizes and flavors; some prefer one, and some the other.

The fine sallad oil, as has been before mentioned, is made from this fruit, for which purpose they are gathered ripe; but for pickling they are gathered when half-ripe, at the latter end of June: they are put into fresh water to soak for two days; after this they throw them into lime-water in which some pearl-ashes have been dissolved: they lie in this liquor six-and-thirty hours; then they are thrown into water which has had bay-salt dissolved in it: this is the last preparation, and they are sent over to us in this liquor: they are naturally as they grow on the tree very bitter, and therefore require all these preparations to bring them to their fine flavor. To some olives they add a small quantity of essence of spices, which is an oil drawn from cloves, nutmeg, cinnamon, coriander and sweet-fennel seed distilled together for that purpose: twelve drops are enough for a bushel of olives: some prefer

them flavored with this essence, but others like them best plain."

At present the use of aromatic substances commercially is not large. It is contended that consumers cannot use flavored olives in sauces or other preparations so freely, as extraneous flavors are introduced which in some cases are undesirable, the unflavored olive permitting greater freedom in use.

For the preparation of the green olives "a la Sevillane," the fruit is first treated with alkali, then washed in clear water, after which it is put into 2 or 3 per cent boiled brine, where after a time fermentation starts, which imparts a slight lactic acid taste to the fruit. It is then washed in water, graded for size, and put in barrels with a 5 or 6% salt, when they are ready for consumption.

The half ripe olives are put in a boiled brine of 12 to 15% for six days, after which they are washed in running water and then put in jars in a 6 to 8% brine with a bay leaf and a sprig of thyme and fennel. Olives prepared in this way are called "a la Provencale." A variation on this method, called "a la Madrilene" is to put the olives in barrels, after the preliminary salting and washing, in 10% brine with red pimiento, pepper corns, laurel, thyme, and tomato purée.

The black olives are gathered at the time of the change in color, and put in water, renewed every 12 hours, until the bitterness has disappeared, which requires 40 to 50 days, sometimes even longer. They are then put into brine.

The large olive "La Tanche" after sorting and cleaning is put directly into a 10 to 15% brine in wooden casks or cement tanks which hold from 4,000 to 6,000 kilos. When the bitterness has been abstracted, they are ready for sale. The brine is decanted and held until the following year.

To prepare them so that they may be ready for sale sooner, the fruit is run over a roller provided with fine points which perforate the skin, after which the olives are put in layers and sprinkled generously with salt. They are stirred frequently, and when they "sweat," they are put in barrels with pepper corns and bay leaves, or in jars with olive oil and condiments, or they may be put in jars without any addition as they are preserved by their own oil and the absorbed salt.

The methods of preparation cited are those used for olives consumed in foreign countries, very few thus prepared being imported, as they are known only to olive connoisseurs.

Imported Green Olives

Nearly all the green olives used in this country come from Spain and are generally known as "Queen olives." In years of shortage a few come from Italy, Greece, and France. They are hand picked, cleaned, treated in the usual way with lye, and washed, but during this process care is exercised to prevent them being exposed to the air as it is desired to retain the green color. They are then graded for size and quality and placed in huge casks or "pipes" with sufficient brine to cover them. The

"pipes" are exposed to the sun to favor the fermentation which requires six weeks or more, depending upon the temperature. During the fermentation, the olives change slowly from deep green to golden. The pipes hold from 160 to 180 gallons and are used for shipping the olives to this country. Ten per cent brine is used for filling the casks, but the brine weakens during the curing and is usually 7 or $7\frac{1}{2}\%$ at the finish.

The Queen olives are hand graded for size on the basis of the number per kilo. The following grades are made:

QUEEN OLIVES

60—70	130—140
70—80	140—150
80—90	150—160
90—100	160—180
100—110	180—200
110—120	200—220
120—130	

They are also graded for quality, as: "prime" or "first quality," "seconds," and "Queen culls." Only the first and second grade are sent to this country though all sizes are, but there is no designation by which the consumer may obtain a desired size. The term Queen olive may mean those having only 60 to the kilo or those with 220 to the kilo.

Some green olives are packed in tins and shipped to this country and a comparatively few are

brought in bottles. The importers prefer to purchase the olives in bulk and pack according to their trade requirements, under the sanitary conditions imposed in this country rather than those found abroad. The olives are transferred from the pipes to bottles and either supplied with fresh brine or the brine from the pipe is carefully filtered and only such addition made as needed to make up the difference. The use of the original liquor gives a decidedly better flavor, though it is often sacrificed in order to get one which is perfectly clear.

The green olive is retailed almost wholly in glass, either in fancy hand packed packages or in pint and quart jars. Many attempts have been made to create a sale in tin containers, but without success as there are decided advantages in being able to see the size and quality. Seeing the fruit no doubt frequently suggests its use and purchase. A few olives are still retailed in bulk but they soon become covered with yeast and other organisms, and have an unattractive appearance.

The origin of the stuffed olive is of very recent date, but by whom originated is not quite clear. According to an authority¹ on Spanish olives, stuffed olives were unknown before 1893-4. It was in 1895 that Señor Picasa, the general manager of the Sevilla Packing Company, had seen olives stuffed with pimientos in Spain, and in the following year introduced them into the United States.

1. H. C. Newcomb, former vice-consul to Spain.

the company packing them under the copyrighted name of "Pimola." In 1897, a Spanish house packed pepper-stuffed olives, and later on other firms also, among the latter many American firms. As the pimiento is grown and prepared in Spain, and labor cheaper there than here, the industry has been practically transferred to that country.

The operation of stuffing consists in removing the pit and filling the cavity with some other substance, particularly pimiento, these forming the bulk of the stuffed olive trade. The bright red of the latter gives a pleasing contrast with the green, and the mild pungency is very agreeable to many persons. Pickled celery, capers, etc., have been used, but were not so favorably received, and at present, the substances used to any extent, aside from the pimiento, are Manzanillos stuffed with pieces of Queens, and some stuffed with anchovies for the South American trade. Pitting machines have been devised, and also machines for stuffing the olives, but the work done by the stuffing machines is crude as compared with hand work. The olives used for stuffing are the Manzanillo which are smaller than the Queen. The sizes are as follows:

MANZANILLO (Stuffed)

180—200	280—300
200—220	300—320
220—240	320—340
240—260	340—360
260—280	

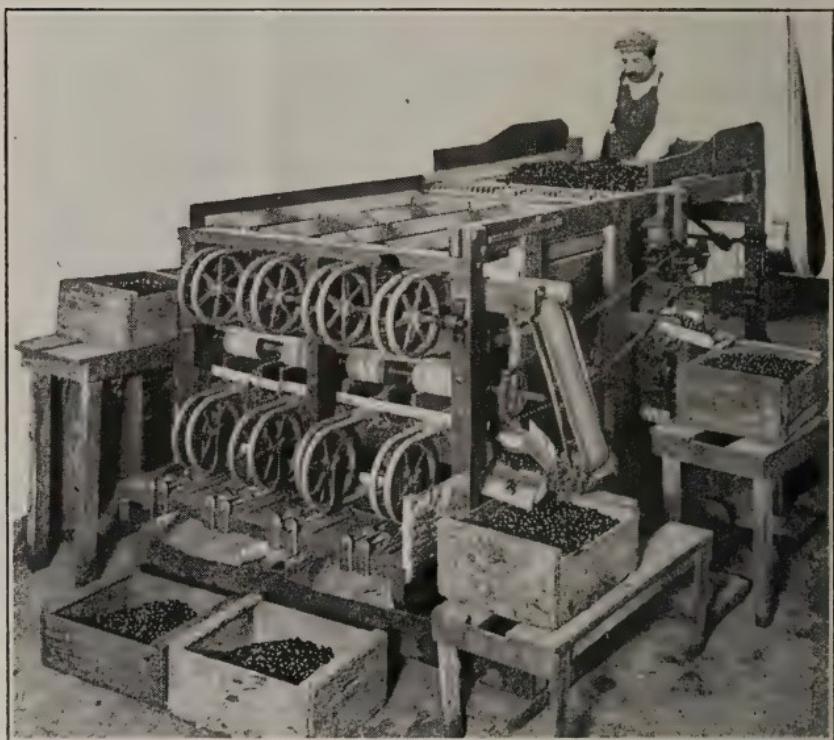
They are packed in barrels of about 45 gallons capacity, and like the Queen, are repacked into individual containers in this country.

A few olives are packed with a mince of capers, anchovies, truffles, etc., and the olives preserved in oil. A few are also packed for garnishing, in which cubes are cut out and the spaces filled with bright peppers.

Domestic

In California the commercially prepared olives are practically all ripe, only a very limited quantity of green ones being prepared. Since the olives, even on the same tree, ripen at various periods, three pickings are made during the season, when olives well colored and of an equal degree of ripeness are taken. In excessively ripe olives, the skin toughens, and the fruit is difficult to pickle. The trees are pruned so as to keep them low enough to be reached by the harvesters on step ladders, in order that all picking may be done by hand. The picked fruit is taken to a central point to be filled into boxes or barrels, for transportation to the factory. For the best grades of olives, particular care is taken during this part of the work to avoid bruising the fruit, which is picked into canvas bags, pails, etc., then poured into barrels partly filled with water, so that the water will furnish a cushion for the fruit. The olives are transported to the factory in these barrels. These precautions are taken as bruised spots soften and become black, and the resulting processed fruit will not be of first quality. Many

growers deliver fruit dry in lug boxes, but bruising and crushing are liable to occur during transportation. The fruit is delivered into a hopper filled with water, then from the hopper into boxes where the fruit is drained. The fruit is delivered in the



Sorting Olives for Size by Machine

factory to be first sorted which is done on a moving belt, and here all stems and defective fruit are removed as the fruit is carried slowly past the workers who sit or stand on either side. In some factories the sorting is done after the fruit is pickled, but is much more difficult due to the change in color

through the action of the lye and of oxidation. The fruit is next passed to the grader, which separates the various sizes. From the grader the three largest sizes are each delivered to a moving belt to be sorted for color, degree of ripeness, and culls, as



Sorting Olives for Quality by Hand

the curing must be modified to suit the particular degree of ripeness, a crisp firm olive requiring a heavier treatment than does a riper, softer-textured one. The olives as sorted, are passed to small side belts, which thus deliver fruit uniform in size and

color to the receiving boxes. Great care is taken in the sorting of olives, different varieties are not mixed, nor even fruit of the same variety but from different localities. In grading for size by machine, 1/16 of an inch is the variation between each size and the next; those less than 10/16 are removed to be used for other purposes. When the minimum is due to the variety and not to stunting, the fruit may be pickled, because aside from the larger proportion of pit, the flavor is equal to that of the large fruit. Usually the smaller olives were used for oil, but more recently are used for relishes and sauces. The sizes upon which the different grades are made are based upon the short diameter of the fruit, and have been adopted by the California Olive Association:

Grade	Number per lb.	Diam. in inches
Standard	120—135....	10/16 — 11/16
Medium	105—120....	11/16
Large	90—105....	12/16
Extra Large.....	75— 90....	13/16
Mammoth	65— 75....	13.5/16
Giant	55— 65....	14/16
Jumbo	45— 55....	15/16
Colossal	35— 45....	16/16

The olives are placed in an alkaline solution, usually sodium hydrate as it is stronger in action than potassium hydrate. The strength varies with the different packers but is generally in the neigh-

borhood of $1\frac{1}{2}\%$. After 6 to 8 hours, the lye is drawn off and the olives exposed to the air in order that they may oxidize and darken, since the lye removes some of the natural color. The operation is repeated with the same strength or less of lye solution and the fruit exposed to the air until examination of the pulp shows that the lye has penetrated to the pit. The lye solution is then replaced with clear water which is changed twice a day, until the lye and bitterness are removed, which requires from 4 to 8 days. The olives are then treated with brine solutions, starting with 1%, and increasing the strength at intervals of about 2 days until about 4% is used, when they are ready to be put in glass jars or cans and sealed.

The brine is used very weak at the start and gradually increased so that the osmotic action may be so controlled as not to cause the fruit to shrivel as it would if placed in a strong solution at the start. Some packers permit the olives to stay in the weak brine long enough for fermentation to take place as done with the imported green olives so as to develop an acid flavor. The more recent tendency, however, is toward packing them with the least possible change, and to depend upon the distinctive natural flavor of the fruit itself. A similar tendency toward retaining the natural color, rather than that induced by oxidation, might be advantageous.

If it be the intent to hold the olives in bulk, they are treated with increasingly strong brines until 10



Curing Vats

to 12½% is used, the latter amount being required to carry them safely through the summer.

The process is modified in practise to suit the conditions, as variations in varieties of fruit, in temperature, and in the lye have to be considered. There are also variations in practise due to individual experience. During the time the olives are in the various solutions they are stirred frequently, so as to change their position in the vats, and also to change the solution in contact with them. The stirring was, and is done yet in some cases, by hand, with wooden paddles, which is laborious besides causing more or less damage to the fruit. Recently compressed air has been piped to the vats and directed into the solutions with sufficient force to keep the olives agitated. This method is said to hasten the action of the lye solutions with consequent improvement in the fruit. It also obviates the drawing off the solutions and the exposure of the fruit to the air, as a certain amount of oxidation takes place in the solution.

As the operators place the olives in the bottles or cans, the soft and defective ones are discarded. The containers are then filled with a 3% brine at a temperature of 175 or 180 degrees F. The air is exhausted, during which the temperature is raised to 185 degrees, and the containers sealed, after which they are processed. The large olives in a 26 ounce glass jar are cooked for 50 minutes; extra large, 55 minutes; mammoth, 58 minutes; and colossal 60 minutes; at 240 degree F. in some factories,

or for a longer period if processed at a lower temperature.

The time required for heat to penetrate to the center of an olive is longer than has been generally supposed. This was determined by carefully drilling into the pit, first with a fine drill and then with increasingly larger ones, until an eighth inch hole was made. The bulb of a small thermometer was inserted, and to prevent heat being carried to the bulb by means of the glass stem, sections of olives were placed around the stem immediately above the olive being tested, and tied securely. Jumbo olives at room temperature placed directly in a boiling bath required on an average fourteen and one-half minutes for the temperature to reach 209 degrees F., which is practically the maximum which can be attained under the conditions. When the olive was placed in cold water and the bath heated rapidly under conditions similar to home canning, the average time required to reach 209 degrees F. was 29 minutes. The former experiment represents a more favorable condition for heat penetration than prevails in factory operations, and the latter probably the least favorable, but both show that in the ordinary process all parts of the olive do not reach the high temperature supposed to be produced by that of the bath for more than a few minutes.

At the University of California ripe olives have been canned without brine. After pickling, the olives have been placed in 3% brine for several days, then heated in the brine to about 180 degrees F.

after which they are taken from the brine, put in the bottles or cans, sealed, and processed. No shrinking, wrinkling, softening, nor change in color is said to take place. By the elimination of the brine in the container, there results a saving in freight of 31.5% with cans and 16.6% with bottles.

The history of the olive and its method of preparation show that no organisms pathogenic to man are normally present and that if such organisms be associated with it in any way, it must be from the outside and through local infection.

More care is required in processing at high temperatures, than at boiling. A high internal pressure is developed inside the cans or jars, due to the expansion of the contents and of the enclosed gases, which has a tendency to loosen or blow off the covers. This tendency may be overcome by applying air or water pressure on the outside of the cans or jars to counteract that generated within. This is done while they are inside the retort and by means of automatic pressure controllers. There is no essential difference in the sterilizing and cooling of tin cans and glass jars, both forms of containers are responsive to treatment with high temperatures and both require proper care and handling. As with pickled olives, however, glass jars permit the purchaser to see the size and the condition of the fruit.

The canning of ripe olives in California was originated by F. T. Bioletti, zymologist in the University of California, and came about through an in-

vestigation in 1889 on the spoiling of olives. When pickled olives were held, the quality deteriorated in some of them, they softened during the summer, and seldom remained in an edible condition for a year. As a result of his experiments on methods of keep-



Packing Olives in Jars

ing, he found that the olives could be sterilized in sealed containers and be kept in edible condition indefinitely. The commercial application of the method and the popularizing of the ripe olive is due to Mrs. Freda Ehmann, a pioneer olive grower, who

applied scientific methods, with marked success, to both the development and canning of the olive.

The sustained scientific work along developmental and preserving lines in this country, has been done mainly by Wickson, Bioletti, and Cruess of the state university staff to whom great credit is due for the advancement made. Many improvements have naturally been made by manufacturers in the preparation of the ripe olive but are held by the factories for their own use solely.

Recently Cruess has developed methods for treating the ripe olive with aerated hot solutions which have permitted the preliminary treatments to be done in 3 to 6 days, instead of as formerly in 3 to 6 weeks. The methods promise to be of great economic value, and have been patented for the benefit of the public.

The olives which are too small or misshapen to be used in the regular pack are sometimes used for other purposes besides oil extraction in which size and appearance are not factors. The flesh is ground and seasoned and thus furnishes a mixture for relishes and sandwich filling, or the flesh is mixed with pickled cucumbers, capers, pimiento, tomato, etc., in various combinations for the same purposes or to flavor sauces. The appetizing ways in which olives may be used alone or in combination, and the attractive dishes which can be prepared from them are endless.

A preparation which has considerable vogue with lovers of ripe olives is to take the olives from the

brine some hours before using and cover them with olive oil. This preparation may be further enhanced by rubbing the dish before using, with a cut clove of garlic. The use of aromatics in the preliminary preparation, then packing in oil, as done by the Greeks, Italians, and Spaniards, with some of their best olives, produce very fine products that are far ahead, in both flavor and food value, of the ordinary preparations.

The olive, though used almost exclusively as a relish or appetizer in this country, is a valuable food. This is true for both the green and the ripe, the difference in the two not being so great as is frequently claimed. The pickled green olive has supplanted the cucumber pickle to a very considerable extent in the trade. The canned ripe olive is distinctive and depends upon an entirely different quality for its favor. As long as the present prices prevail, they can not be considered on the basis of staples or in competition with many other foods in furnishing nutritive elements.

The flesh of the American olive consists of about 80 per cent of the fruit, and of this the solids average 38 per cent, oil 25 per cent, and protein 1.2 per cent.

In spite of the fact that olives have been used as a food from time immemorial, very little systematic analytic work seems to have been done on the whole fruit in the various stages of maturity and in determining the effect of the various treatments for the removal of the bitterness. Much of the

analytic work has been devoted to analyses of the oil and to methods for determining adulteration. The methods followed in this country and abroad are not the same and the results are therefore not comparable. It seems strange that so old and so commercially important a fruit has not been investigated to the minutest detail.

It is stated that the olive on reaching full size increases in weight and oil content as it matures, the various stages being approximately determined by the change in color from green to yellow, red, and finally black. When, however, one finds analyses of typical fruit of one variety and from the same place which show the flesh of the green olive to contain 23.55 per cent; yellowish green, 20.37 per cent; red, 27.35 per cent; and purple to black, 24.89 per cent oil, it discounts the color value. Other available analyses show similar discrepancies between the chemical composition and the color test as indicative of maturity. Variation in composition occurs in the same variety of fruit grown in different places as well as in the different varieties and, as with other fruits, one is dependent upon the skill of the packer in selecting raw stock and in handling it in the process of manufacture, for the quality of the article received. It is only natural to expect that a product containing so much oil and subjected to the action of lye, might be greatly changed during its preparation. The data available, however, does not sustain this premise, but shows that very little change actually takes place.

LITERATURE

- Andran, H. M.....Les conserves des petits menages.
- Armstrong, E. F.....The simple carbohydrates and the glucosides, 1912.
- D'Aygalliers, P. D.....L'olivier et l'huile d'olive, 1900.
- Bourquelot, Em. and Vintilesco, J...Compt. Rend. 147, 533, 535, 1908.
- Buckland, A. W.....Our viands, 1893.
- Chalmers, T. W.....The reduction and treatment of vegetable oils, 1918.
- Coupin, HenriLa conservation des fruits, des lugumes, des graines.
- Cruess, Wm. V.....Home and farm food preservation, 1918.
- Gracey, Wilbur T.....Olive growing in Spain. Special consular report, No. 79, Dept. of Com., 1918.
- Green, Mary E.....Food products of the world, 1895.
- Haas, Paul and Hill, T. G...Chemistry of plant products, 1913.
- Hilts, R. W.....Chemical study of the ripening and pickling of California olives. Bul. 803, Bu. of Chem., Dept. of Agr., 1920.

- Lemery, L., Translation by Hay, D...Treatise of all sorts of food, 1745.
- Loudon, J. C.....Loudon's encyclopedia of plants, 1866.
- Martyn, CharlesFoods and culinary utensils of the ancients.
- Mason, CharlotteThe lady's assistant, 1778.
- Pellerin, G.Guide pratique de l'expert chimiste, 1910.
- de Savigny, G. B.....Conserves, salaisons, et confitures de menage, 1909.
- Thudichum, J. L. W....Cookery, its art and practice, 1895.
- Wickson, E. J.....California fruits, 1910.
- Willis, Oliver R.....Practical flora, 1894.
-Fig and Olive Journal, vo. 4, No. 11, Apr. 1920.
-Seal of safety, 1915.

